

**INFLUENCE OF SMASSE TEACHING APPROACH ON SECONDARY
SCHOOL STUDENTS' MOTIVATION AND ACHIEVEMENT IN
BIOLOGY IN BOMET SUB-COUNTY, KENYA**

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Requirements for the Award of the Degree of Master of Education (Science Education) of
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Egerton University

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DECLARATION AND RECOMMENDATION

DECLARATION

This is my original work and has not been submitted for an award of a Diploma or a Degree in this or any other University.

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RECOMMENDATION

This Thesis has been submitted for examination with our approval as University supervisors

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DEDICATION

I would like to dedicate this work to my family, my wife Anitha, my children Ian, Cynthia, Allan my sisters Eddah, Damaris my niece Mercy. Thank you for inspiration for the endless efforts and support during the study. God bless you abundantly.

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ABSTRACT

Science subjects are the backbone of the scientific and technological advancements in the world. In Kenya, science teaching in secondary schools is seen as one of the ways of enabling the country achieve her scientific and technological development and thus realise Vision 2030. Performance in science subjects in secondary schools in Kenya has been below average. The poor performance in the national examinations has been attributed partly due to poor teaching approaches employed by teachers. In an attempt to address the poor performance in Biology, the Strengthening of Mathematics and Science in Secondary Education (SMASSE) teaching approach was introduced in Bomet Sub-County in 2004. However, it is not clear how this approach is influencing students' motivation and achievement in the subject. Therefore this study attempted to fill this gap. The objectives of the study were; to find out whether SMASSE approach has influenced achievement, motivation, whether there is gender difference in achievement and motivation in Biology. The study used Causal-Comparative research design. The target population was the 2016 Form Three students and their biology teachers. There were 3000 Form 3 students in this class in the Sub-County. The researcher used stratified and simple random sampling methods to identify the schools and the respondents to participate in the study. The researcher sampled 12 schools and 340 students participated in the study. Twenty two Biology teachers in the twelve schools filled the questionnaire. The research instruments used were; Teachers Questionnaire on Students' Achievement in Biology (TQSAB) and Students Motivation in Biology Questionnaire (SMBQ). The instruments were validated by experts in the Department of Curriculum, Instruction and Educational Management. Piloting was done in 4 schools in Sotik Sub-County. Cronbach's alpha coefficient was used to determine the reliability where TQSAB had a reliability of 0.7231 and SMBQ had a reliability of 0.8391. The threshold for acceptance was $\infty \geq 0.70$. Descriptive and inferential statistics were used in the analysis of data. Means, standard deviations, regression analysis (R^2) and t-tests were used in data analysis. All statistical tests were subjected to a test of significance at coefficient alpha (α) of 0.05. Results show that SMASSE teaching approach positively influences students' achievement in biology. The results however show that the teaching approach has no influence on students' level of motivation to learn biology. The findings also reveal that males perform better than females when both are exposed to the approach. However, gender does not influence motivation when the approach is used. This study provides a basis for enhanced use of SMASSE approach.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASEI	Activity, Student-Centered, Experiment and Improvisation
BSCS	Biological Science Curriculum Study
CATS	Continuous Assessment Tests
CEMASTEA	Centre for Mathematics, Science and Technology in Africa.
GOK	Government of Kenya
INSET	In -service Education and Training
JICA	Japan International Co-operation Agency
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KIE	Kenya Institute of Education
MOE	Ministry of Education
MOEST	Ministry of Education Science and Technology
MULTICATS	Multiple Continuous Assessment Tests
NSSP	Nuffield School Science Project
PDSI	Plan, Do, See and Improve
QUASO	Quality Assurance and Standards Officer
SMBQ	Student Motivation in Biology Questionnaire
SMASSE	Strengthening of Mathematics and Science in Secondary Education
SPIAS	SMASSE Project Impact Assessment Survey
SPSS	Statistical Package for Social Sciences
SSP	School Science Project
TIPDP	Teachers' In-Service Professional Development Program
TQSAB	Teachers' Questionnaire on Students' Achievement in Biology.
UNESCO	United Nations Educational Scientific and Cultural Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Science education is crucial in human lives and in the development of nations around the world, as it contributes much towards economic empowerment of nations (Aoki,2001). Science knowledge has been utilized in scientific inventions in medicine, engineering and technology towards solving most of the human problems (Das, 1985). Over the years, science has contributed to the improvement of quality of human life (Mori, 2017). Human needs have been met through scientific inventions. Science yields apart from ‘finished’ learners, new knowledge, new skills, and new desirable attitudes (Kerich, 2004). Science knowledge is useful for improving human life on earth. The subject matter of science is the material world. Teaching science would in part help students with the established body of scientific knowledge appropriate to their needs, interests and capacities (Millar, 2004).

There have been several changes in science teaching approaches and methods. For instance, the European countries were stunned when the Soviet Union launched the Sputnik in 1958 leading to examination of their Science curricula (Maundu, Sambili & Muthwii, 1998). A number of innovations came into being with far reaching effects across many parts of the world. In the United Kingdom, Nuffield Science Project (NSP) was launched in 1962. This project was sponsored by the Nuffield Foundation. In Kenya, Science subjects were included in school curriculum through the School Science Project (Kenya Institute of Education, 1969). The School Science Project (SSP) was designed especially for those schools with well equipped laboratories. The SSP required students to carry out investigations and discuss their findings and finally draw conclusions with the help of their teachers. It also involved the use of the locally available materials. Wachanga (2005) pointed out that in 1984; the 8-4-4 education system was implemented in Kenya with the aim of making education more relevant to the needs of Kenyan society. The 8-4-4 education system introduced learning of biology, physics and chemistry in all secondary schools in Kenya (Kenya Institute of Education, 1992) currently called Kenya Institute of Curriculum Development (KICD). This forms what is called science subjects in secondary schools. The science syllabi emphasized on science content and methods which could be directly applicable to the immediate environment of the students.

Biology curriculum has also undergone several changes. In 1958, Biological Science Curriculum Study (BSCS) was established in the United States with the following objectives; to examine classroom biology materials available before 1960, produce a biology curriculum which encourages creative and imaginative approach to study of Biology, the teaching and learning of Biology through philosophy inquiry and use of learner's environment as the starting point in biology education.

BSCS influenced the launch of Nuffield Science Project (NSP) in United Kingdom in 1962. (Maundu, Sambili & Muthwii, 1998). In Kenya, the development of biology curriculum was initiated by the Kenya Institute of Education, NSP, and UNESCO through the African Curriculum Development Centre (ACDC) in 1963. The above attempts didn't bear much fruits, therefore other projects were undertaken. There was the Nuffield Science Project of 1969 which adopted the learning of the natural science. (Biology, Physics and chemistry) in selected secondary schools in Kenya. The introduction of the 8-4-4 secondary school biology syllabi followed a recommendation of the Presidential Working Party in 1981 that stipulated the 4-year biology course. The Importance of studying biology are; Apply the knowledge gained to improve and maintain the health of the individual, family and the community, relate and apply relevant biological knowledge and understanding to social and economic development in rural and urban settings, demonstrate resourcefulness, technical skills and scientific thinking necessary for economic development, acquire firm foundation of relevant knowledge, skills and attitudes for further education and training in related scientific fields (Majani, Kelemba & Maina, 2003).

A national assessment survey carried out in 1999 by the Ministry of Education (MOE), resulted in the revision of secondary education Biology curriculum. The revised curriculum was to address aspects necessary for industrial transformation by the year 2020 (MOE, 2002). The revised curriculum emphasized project method of teaching. The biology syllabus was later revised in 2002 with the syllabus having many practical activities unlike the previous one that had small scale practical activities (MOE, 2002). This is still the syllabus in use to date (2017).

Poor performance in Biology and other science subjects in terms of quantity and quality grades is perhaps what prompted the Government of Kenya through the Ministry of Education, Science

and Technology (MOEST) in conjunction with the Government of Japan through Japan International Co-operation Agency (JICA) to jointly launch Strengthening of Mathematics and Science in Secondary School Education (SMASSE) project. The project then introduced the SMASSE teaching approaches. The low achievement in science is seen in poor performance in examination and it's an indicator of poor teaching approach (Oyaya & Njuguna, 2000). SMASSE program was then launched in 1998 in nine districts of Kisii , Gucha, Kakamega, Makueni, Kajiado, Murang'a ,Maragua, Butere-Mumias and Lugari in Kenya as phase one to cover 4 cycles. The national examinations results of 2003 before the project are shown in Table

Table 1: Number of Students Per Grade in KCSE Nationally in 2003

Subject	B+ and Above	% Grade	D+ and Below	% Grade	Total
Biology	11339	6.1	103282	55.5	185,319
Physics	5571	9.8	26768	47.5	56,333
Chemistry	12,341	6.2	140,455	71.5	197608
Mathematics	9903	4.8	158,867	77.4	205,232
Overall	39,154		429,372		617,492

Source: KNEC results, (2003).

The results in Table 1 indicate that the majority of the candidates obtained low grades of D+ and below. There are few number of quality grades in physics and mathematics compared to biology. There are more number of quality grades in chemistry than in biology. The data shows that there is a problem in both quality and quantity of good grades in all science and mathematics subjects. In order to address the situation, change had to occur in the classroom. SMASSE project was therefore conceived as an intervention measure to upgrade the capability of young Kenyans in science and mathematics. In-order to identify the root causes of this poor performance, the project was carried out in 9 pilot districts stated earlier. The project was aimed at identifying those factors that contribute to this state of affairs. On the basis of this, a program was formulated for intervention through In-service Training (INSET) of teachers' and sensitization of key stake holders. The main problem areas that the project could address were: poor attitude of the learners and key stakeholders, inappropriate teaching methods and approaches, poor content mastery by the teacher, poor utilization and distribution of school resources and inadequate supervision from ministry of education and technology (SMASSE,2004) .

SMASSE project was an In-Service Education Training (INSET) program that sensitized teachers on teaching strategies that may address the above problems and improve science performance in national examinations. The institutionalization of INSET was for capacity building with the aim of changing the teachers' attitudes, teaching approaches and methods along with prudent use of school resources and improvisation as far as possible and as far as academic activities are concerned (SMASSE, 2004). SMASSE teaching approach involves; Activity, Student -centered, Experiments and Improvisation (ASEI) condition and Plan, Do, see and improve (PDSI) movement (CEMASTE,2016).

ASEI is a SMASSE initiative whose focus is to assist teachers to reflect on their teaching strategies and acquire skills for effective teaching and for efficient learning to occur (Oyaya & Njuguna, 2000). It also aimed at encouraging teachers to focus on institutional strategies that will support meaningful learning and make lessons interesting to learners. The ASEI teaching approach advocated for a shift in both the teachers' thinking and practice from the teacher-centered approaches to student-centered approaches (Ogolla, 2001). PDSI is a teacher's approach to teaching that involved proper planning of the lesson, actual teaching, seeing it and including feedback from other teachers and improving where it requires, making the lesson delivery effective (SMASSE,2005).

As in the case nationally, Bomet Sub-county has been posting dismal performance in science subjects over the years. This had been attributed partly due to poor preparedness and approaches employed in teaching of science (SMASSE, 2004). The Kenya Certificate of Secondary Education results analysis before INSET on SMASSE teaching approach in Bomet Sub-County is shown in Table 2.

Table 2: Students' Performance in Science Subjects in Bomet Sub-County (2000-2004)

	2000	2001	2002	2003	2004	
Subject	Mean Score	Mean Score	Mean Score	Mean Score	Mean Score	Mean Score
Biology	4.16	4.73	4.83	5.023	5.256	4.790
Physics	3.89	4.09	4.647	4.789	4.905	4.344
Chemistry	3.84	3.44	3.723	3.952	4.072	3.783
Overall	3.963	4.087	4.400	4.588	4.744	4.306

Source: District Education office, Bomet (2004)

In Table 2, the performance of Biology and Physics shows improvements from 2000 to 2004 as compared to Chemistry. Performance in Biology compared to other science subjects is higher. There has been improvement in biology throughout the five years before the introduction of SMASSE program in Bomet Sub-County.

SMASSE program was introduced in Bomet District Currently Bomet Sub-County in 2004. This was with a view of improving the performance in the science subjects. Biology teachers were supposed to implement the teaching approaches in their own schools with a promise of the supervision by the trainers. The results after the INSET are shown in Table 3.

Table 3: KCSE Analysis for Science Examination in Bomet Sub-County (2005-2012)

	2005	2006	2007	2008	2009	2010	2011	2012	
Subject	Mean Score	Mean Score	Mean Score	Mean Score	Mean Score	mean Score	Mean Score	Mean Score	Mean Score
Biology	3.991	3.1296	5.4873	5.0207	4.395	4.5336	5.1379	4.57604	4.5339
Physics	4.4201	4.0455	4.9186	4.5807	4.5445	4.5359	4.5436	4.7007	4.5362
Chemistry	3.2666	3.0566	3.6782	3.5423	3.450	3.6520	4.4190	4.1513	3.6520
Overall	3.8926	3.4106	4.6947	4.3812	4.1298	4.240	54.6976	4.4760	4.2359

Source: Bomet Education Office (2012)

Table 3 shows the performance in Biology and other science subjects after the INSET. The performance in Biology has been higher compared to other science subjects. When pre-INSET (2004) and Post-INSET (2009) mean results in Biology are compared, a negative deviation is

arrived at but the quality grades have improved. There was an improvement in physics after the INSET where the average total mean in 2004 was 4.344 compared to post- INSET which was 4.5362. Performance in chemistry didn't improve where the average total mean difference was -0.132. This study therefore tries to find out whether the INSET program on SMASSE teaching approaches have had any influence on this performance particularly in biology. Table 4 shows performance in Science subjects after the cycles were completed. The programme ended in 2013, being provided at the sub-county level.

Table 4: Students Performance in Science in Bomet Sub-County (2013- 2017)

Year	2013	2014	2015	2016	2017	
Subject	Mean	Mean	Mean	Mean	Mean	Mean
	Score	Score	Score	Score	Score	Score
Biology	4.217	4.197	3.600	2.510	2.320	3.368
Chemistry	3.60	4.551	4.616	2.450	2.551	3.556
Physics	3.367	4.500	4.730	3.110	2.825	3.7706
Overall	3.731	4.416	4.215	2.690	2.565	3.544

Source: Bomet Education office, 2018

Table 4 shows that performance drastically declined in all science subjects from 2016. This was due to changes undertaken by the Ministry of Education, Science and Technology in conjunction with The Kenya National Examinations Council in administration, marking and release of examinations. It appears that the measures did not favour candidates as shown by the results. Biology performance was very dismal in the consecutive years of 2016 and 2017.

Barchok (2006) in his study on students' attitude towards science and achievement found that student's motivation towards science learning, in turn affects achievement. What a teacher expects the students to achieve and how he conveys it carries a lot of influence. Motivation is the desire to do something (Oyaya & Njuguna, 2000). Students' motivation can be intrinsic or extrinsic. Veroff (2016) found that poor performance in national examinations makes the students lose motivation and consider it a waste of time to concentrate on subjects they will not

pass. On the contrary, Wachanga (2000) in his findings on effect of inquiry teaching approach in learning chemistry noted that the cause of most failures in schools might not be due to insufficient or inadequate instruction, but perhaps due to active resistance by the learners.

SMASSE teaching approach was also expected to bridge a gap that exist in the performance of boys and girls in mathematics and science subjects in the majority of the co-educational schools (SMASSE,2004).

1.2 Statement of the Problem

Students' achievement in Biology in Kenyan secondary schools is below average. In an attempt to address this poor achievement, the Government of Kenya introduced Strengthening of Mathematics and Science in Secondary school Education (SMASSE) teaching approach. However, it is not clear how this approach influences students' motivation and achievement particularly in Bomet Sub-County. This study therefore attempted to fill this gap. This study therefore examined whether SMASSE teaching approach has any influence on students' motivation and achievement in secondary school Biology in Bomet Sub-County.

1.3 The Purpose of the Study

The purpose of this study was to explore the influence of SMASSE approach on students' motivation in Biology in Bomet Sub-County secondary schools. The study also assessed and described the influence of the approach on students' achievement in Biology.

1.4 Objectives of the Study

The study was guided by the following objectives.

- (i) To find out whether SMASSE approach influenced secondary school students' achievement in Biology.
- (ii) To examine whether SMASSE approach has any influence on the level of motivation of students in Biology.
- (iii) To asses whether there is students' gender difference in Biology achievement on exposure to SMASSE approach
- (iv) To asses whether there is students' gender difference in the level of motivation in Biology on exposure to SMASSE approach.

1.5 Hypotheses of the Study

The following null hypotheses were tested in this study:

Ho1: There is no statistically significant influence of SMASSE approach on students' achievement in biology.

Ho2: There is no statistically significant influence of SMASSE approach on students' level of motivation in biology.

Ho3: There is no statistically significant students' gender difference in achievement in biology on exposure to SMASSE approach.

Ho4: There is no statistically significant students' gender difference in the level of motivation in biology on exposure to SMASSE approach.

1.6 Significance of the Study

The study was undertaken in Bomet sub-county since biology teachers had been in-serviced on SMASSE teaching approach. It was therefore necessary to find out its influence on students' motivation and achievement in the subject so as to inform decision making and resource allocation.

The study may help education policy makers come up with ways of improving future programs aimed at better performance in Biology. The findings may influence information, decision and action towards improving teaching and learning of Biology in Bomet Sub-County schools. The study may also help to sensitize teachers' position as far as SMASSE approaches are concerned and to pay more attention to the areas in the program that requires improvement. The findings of the study may also assist students develop higher motivation towards learning of biology. Biology trainers may also find useful in trying to improve on the ways of delivery of their services in any future training. The study will also be important to researchers and scholars. Other than increasing the body of empirical literature on the topic, this study might also become a point of reference for future researchers. Researchers would also identify research areas from this study.

The findings study may also play an important role in the formulation of strategies aimed at improving areas of students motivation and improvisation of science materials without relying on the conventional chemicals and apparatus that involve a lot of finances which the schools and the government may not be able to provide at the right time. Teachers will also be sensitized on how to make learning of biology more interesting to the learners and demystifying some of the

held ideas that biology only involves the use of realia for learning to be effective.

1.7 Assumptions of the Study

This study it assumed that, the information provided by the respondents was true and relevant responses of their perceptions, feelings and judgments of the question items in the questionnaire. The Second assumption was that the presence of the researcher in the schools did not affect their responses or influence the information that was given by the respondents .Third assumption was that teachers who have 4 years experience and trained in SMASSE perform at the same level.

1.8 The Scope of the Study

The study involved the sampled Form 3 students in the Bomet Sub-County schools doing Biology. Biology teachers who had been sensitized on SMASSE teaching approach were eligible respondents in this study. This study covered aspects of students' motivation and achievement in biology and how SMASSE approach had influenced them

1.9 Limitations of the Study

The study focused on the students in form three doing Biology in Bomet Sub-County. This meant that the generalization of the findings was confined to the Sub-County. The researcher covered only one Sub-county which may have unique settings, thus the findings of the study could not be used to generalize results for the whole country. For conclusive results, all Sub-Counties in Kenya should be studied.

1.1.0 Definitions of Key Terms

Achievement: It means something that has been accomplished especially by hard work and ability (Maundu,1986). In this study, it refers to the students' attainment of better scores in the joint examinations in biology when the teachers use SMASSE teaching approach.

Approach: Is a way of dealing with an educational issue (SMASSE, 2004). In this study, it is used to mean the way of teaching science in secondary schools. In this case approach is SMASSE teaching approach.

Biology: This is a science that deals with the study of living things and how they relate with each other and their environment (SMASSE,2004). In this study it is used to refer to one of the subjects offered in secondary schools.

Gender: Gender refers to the roles assigned to the members of the opposite sex, male or female (Davidson & Honing, 2003). In this study is taken to refer to the difference between boys and girls in socio-cultural aspects rather than physical aspects only.

Influence: It is the effect that something has on somebody or something (Jude *et al.*, 2007). In this study the influence is used to mean the relationship between SMASSE teaching approach and teaching and learning of biology in Bomet Sub-County secondary schools.

Motivation: Motivation is a desire to achieve through own's effort ,to excite to do something (Ayiro, 2010). In this study is used to mean the desire by the students to learn biology biology when exposed to SMASSE approach.

MultiCATS : These are multiple continuous assessment tests that are done jointly by schools in the sub-county.The scores are graded using a common grading system. In this study they refer to the exams done by form three during that period.

Scores: This is the determination of the level of mastery of a particular subject (Kasomo, 2006). The scores can then be used for grading. In this study scores are the numerical values obtained in biology joint examination.

SMASSE Teaching Approach. This refers to a teaching approach that incorporates two conditions; PDSI and ASEI.In this study both conditions requires that the teacher plans for the lesson,execute it and involve learners in experiments and improvisation of apparatus where the conventional ones are unavailable (SMASSE,2004).

Teachers' In -service Professional Development Program (IPDP): This refers to sessions teachers undergo in order to introduce changes in the teaching approaches without changing the curriculum (Igenya & Thomson, 2002). For this study, IPDP refers to the sessions teachers underwent during the INSET centers on SMASSE approach.

1.1.1 Organisation of the Study.

The study is organized into five chapters. The first chapter deals with introduction that gives the background information of the study, the second chapter deals with the literature review .The third chapter deals with methodology, the fourth is results and discussions and the last chapter is on summary ,conclusions and recommendations. All the chapters have subsections where there are discussions on the same.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature review on the areas relevant to present study. The first section deals with the students' motivation in biology followed by students' motivation and gender difference in learning science. The third section deals with the effect of practical in science achievement, followed by trends in teaching approaches in science education. The next section deals with teachers' in-service professional development program followed by the influence of intrinsic motivation on students' achievement. This section is followed by the influence of school leaders in students, motivation and achievement. The next part of this chapter deals with the theoretical framework and finally the conceptual framework of the study. All the sections described the SMASSE approach and its influence on Students' motivation and achievement.

2.2 Students' Motivation in Learning Biology

Keller's (2014), motivation theory stated four steps for promoting and sustaining the learning process, these are: Attention, Relevance, Confidence and Satisfaction (ARCS) model. The theory further stated that in order to grab the learners' attention, learners must be actively involved by use of hands-on methods. Hands-on activities form the core reasons for improvisation and performance of many small scale experiments (SMASSE, 2007).

Keraro, Wachanga and Orora (2007) found that students are more motivated to learn Biology when Cooperative concept mapping teaching approach is used. This method when used compared to other regular methods of teaching improves students motivation in biology. Keraro and Shiusa (2009) in their study on Using Advance Organizers to Enhance Students Motivation in learning Biology found that advance organizers enhance learners' motivation in biology. Wambui and Wahome (2014) found that students' could be motivated to learn Biology through change of approaches and methodology, imparted through teachers' in-service training, Seminars and conferences at different levels, and that focus should be directed to the learners and the community.

Poor performance in science compounded with students' lack of motivation and poor approaches to teaching and learning of science led the Government of Kenya to introduce PDSI and ASEI

approaches through SMASSE to help teachers achieve their lesson objectives and ultimately make students improve in their national examinations (SMASSE, 2004). Veroff (2016) in his study on what drive people to success, found that people who are not good at doing things will inevitably experience failure and those who are competent will experience success. Biology teachers required better methods and approaches to realize success in their work. Unless students on the other hand become motivated, it becomes difficult for teachers to manage class, communicate effectively with the learners, and apply effective class control measures. Atman & Monroe (2004) found that an increase in student engagement and motivation can in turn improve students' academic achievement. Students with high levels of motivation are likely to be 'engaged in learning in a deeper and self-regulating fashion'. This study therefore examines the influence of SMASSE teaching approach on students' motivation and achievement in biology.

2.3 Students' Gender Difference in Motivation to Learn Biology

Barchok (2006) studied the relationship between gender stereotyping of science subjects and students attitude towards science and found that the majority of the students generally perceive that 'Girls are not as good as boys in science subjects'. Ministry of Education (2007) reveals a study of historical development that girls were encouraged to study humanities subjects that would prepare them for their roles in the family. Therefore little was done to provide girls' schools with science, mathematics and technology related infrastructure such as laboratories and equipment or facilities for learning of science and technology subjects. This scenario is yet to change due to promotion of equal opportunities to learning of science (MOE, 2007)

Teachers contribute in propagating gender segregation by expecting boys to do well in science, especially in co-educational schools (Oyaya & Njuguna, 2000). Trowbridge and Bybee (2004) found that adolescent girls are often afraid of being wrong in responding to a question in front of boys and as a result girls are often bypassed as boys are more willing to offer answers and they benefit from the class interactions. Socio-cultural beliefs that difficult tasks are a male domain and girls are associated with lighter things and they give up in subjects viewed hard at the beginning. Keraro and Shiusa (2009) found that male students had a significantly higher level of motivation than their female counterparts when advance organizers are used in teaching biology.

2.4 The Effect of Practicals in Biology Achievement

Millar (2004) stated that practical work is any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials. Aduda (2010) found that the current science syllabus was intended to promote creativity and improve achievement. The study also noted that, most schools systems are driven by the single desire to pass exams and little attention is paid to creativity and practical activities and students are taught to memorize concepts. Some of the subjects are taught in an abstract manner instead of engaging the students in practical activities. He also pointed out that most teachers resort to buying test papers instead of preparing them on their own leading to poor assessment in schools that eventually lead to inadequate preparation of students in national examinations. This poor teaching approach has been seen to be a major contributor to poor performance in secondary school science. Students' attitude towards science also contributes to dismal performance. Akubuiro and Joshua (2004) in their study, found out that when an individual has an interest or positive feeling towards any object, and he/she behaves favorably towards that object. Mutie and Ndambuki (2007) found that Social problems may also hinder academic achievement. Teachers may dislike the students because of poor performance, students' fear of failure to meet the expectations of the parent and not getting the homework done in science subjects. SMASSE teaching approach therefore focuses on practical activities at every lesson (SMASSE, 2007).

2.5 Trends in Teaching Approaches in Science Education

Teaching and learning of science has been a subject of discussion for a long time by educationists. The discussion is often centered not only on what is taught but how its taught. The teacher is thought to have very little direct control over what is taught because it is already prescribed in the curriculum which also suggests approaches and methods to be used for teaching (Ogolla, 2001). A teacher is tasked with the selection of the approaches to be used in presentation of the lesson. Good teaching is largely a matter of personal aptitude and motivation and is acquired through planning and selection of approaches that will results in effective learning. There are three basic facets in science education; that is learning science, learning about science and doing science through adopting an approach to be used in the classroom. Science teachers should be conscious about some of the aims of teaching science in secondary education (MOE, 2002, 2005, 2006). These are:

- i) To help learners develop a positive attitude towards learning science.

- ii) To develop in the learners, capacity for critical thinking and problem solving in any situation.
- iii) To foster and develop an individual with a scientific way of thinking and who can communicate this with others.
- iv) To enable learners make sense of their world by helping them restructure their ideas in useful and skillful way. The learners should build coherent scientific perspectives that can relate to what they learn and to the world in which they live in.

The approaches that have been used in science education are:-

- i) Didactic approach
- ii) Expository approach
- iii) Heuristic approach
- iv) Inquiry approach
- v) Constructivist approach
- vi) SMASSE approach (SMASSE, 2009)

2.5.1 Didactic Approach

Laliberte (2015) in his study on didactic approach found that when a teacher engages in didactic instruction, the teacher presents models to the students for mutual contemplation. Both are actually thinking about models placed before them, as a result, both move toward a more accurate understanding of the ideas contained in the object. This approach is where students are given rigidly formulated statements which they have to memorize and regurgitate when required by the teachers. Little or no emphasis is placed on understanding. Learners were simply made to cram things. This approach believed that human brain was a blank store whose knowledge can be pumped and stored (Rabari ,Kilonzo and Ng'eny ,2004).SMASSE approach assumes that the learner has prerequisite information on the topics to be presented by the teacher (SMASSE,2004).However the approach is not suitable for science teaching since no practical are involved.

2.5.2 Expository Approach

Ausubel (1963) proposed expository teaching model to encourage meaningful rather than rote reception learning. In his approach to learning, teachers present material in a carefully organized, sequenced, finished form. Ausubel believes that learning should progress deductively from general to specific. This is the approach where the teacher's talk is dominant and involvement of students in practical activities. It's a teacher centered approach. The teacher gives facts and explains concepts and gives illustrations. Anything taught practically is through teacher demonstration. Student participation is limited to listening, answering and asking questions and writing notes as lesson progresses. The approach is not considered good for teaching of science (Rabari ,Kilonzo & Nge'ny ,2004).

2.5.3 Heuristic Approach

Armstrong (2014), Jian & Rui (2016) stated that heuristic approach refers to a particular method of teaching allowing the students to learn by discovering things themselves and learning from their own experience. Students will be encouraged to try and solve problems through critical thinking and reasoning. This way, problem will be solved through discussion among students with the help of the teacher. Heuristic is the art and science of discovery and invention. This approach asserts that the learners could be trained to discover scientific skills by using faculties of observation, reasoning and memory. Learners are involved in observation, recording, analyzing data and drawing conclusions on their own. This is better approach to science than the expository approach. However, the approach consumes a lot of time hence less coverage of the syllabus, therefore most teachers don't prefer using the approach(SMASSE,2009)

2.5.4 Inquiry Approach.

Wachanga (2015) in his findings on Effect of Co-operative Class Experiments in Chemistry suggested that like co-operative learning, the inquiry approach should be emphasized more at teacher training institutions and in-service courses in the universities and tertiary colleges for effective delivery of teaching. This is a student -centered approach where the teacher involves students in activities that help in the development of scientific skills such as the ability to make observations, perform experiments, collect data and make deductions and presents results. There was the Nuffield Science Project which encouraged pupils to carry out experiments which could bring better understanding of scientific concepts (Maundu, Sambili & Muthwii,1998). The

philosophy that followed this approach was, ‘I hear I forget, I see and I remember and I do and I understand’. The teachers’ role is to guide students clarify instructions where necessary and being available to answer any question that may arise in the course of the activities. The approach is believed to be effective but consumes a lot of time.

2.5.5 Constructivist Approach

Chen (2015) in his study found that constructivist teaching approach assist learners to construct knowledge and emphasizes presenting learning activities in meaningful context. It provides an alternative theoretical foundation for rethinking and redesigning teaching practices. Constructivism provides a sound theoretical foundation for teaching any complex knowledge domain. This approach is based on the fact that when the learners enter formal education, they have already interacted with the environment and have developed ideas and concepts in relation to what they have experienced. The role of the teacher here is to provide guidance by giving students challenges that would help them correct their misconceptions and enable them draw correct scientific concepts. The teacher do this through class discussions, students experiments, demonstration, visual aids, audio, charts, diagrams and models. This approach helps learners to test their understanding using scientific approach. The activities should encourage the ability to plan and carry investigations in which students observe, compare, describe, note, and express themselves (SMASSE, 2004). However the approach consumes a lot of time.

2.5.6 SMASSE Approach

This approach aims at encouraging teachers to focus on instructional strategies that will support meaningful teaching and learning through improvisation (Oyaya & Njuguna, 2000). The SMASSE approach involves; Activity, Student, Experiment and Improvisation (ASEI) and Plan, Do, See and Improve (PDSI). The approach advocate for a shift in the teachers’ thinking and practice. The approach is a shift from teacher-centered to student-centered, from knowledge based to activity-focused teaching and learning, from theoretical to experimental and from fewer teacher demonstrations to many small scale experiments and improvisation. The teacher should be able to demystify conventional experiments by scaling them down. In performing experiments, ASEI and PDSI approach advocates for incorporating improvisation where conventional equipment, apparatus, chemicals and materials are not available. The SMASSE

approach equip teachers with effective classroom practices believing that the battle against poor performance in biology needs to be won in the classroom (Kizito, 2008). Improvisation creates awareness in the unlimited opportunities that exist in seeking and using locally available materials. Improvisation of laboratory equipment and materials should remain a major pre-occupation of the biology teacher because of the following reasons:

- i) It encourages creativity.
- ii) Acceptable results can be obtained with the help of the non-standard equipment
- iii) It saves money that can then be used to buy apparatus that cannot be successfully be improvised (SMASSE, 2004).

The SMASSE teaching approach is for the student and the emphasis is on students' understanding by actively engaging the learners in constructing knowledge (Ogola, 2001). This movement recognizes the power of improvisation in which the teachers carefully identify and selects teaching and learning materials from the local environment. In performing experiment, the approach advocate for incorporation of improvisation where the conventional equipment, apparatus, chemicals, materials are not available. Activity, Student, Experiment and Improvisation (ASEI) also advocates for integrating practical work with theory lesson by providing a bridge to enhance learning (SMASSE, 2004). Improvisation also creates awareness in the teacher of the unlimited opportunity that exist in seeking and using locally available resources. ASEI condition is therefore attained through the use of PDSI. This involve the institutionalization of In- Service Education Training (INSET) for capacity building with the aim of changing teachers' attitudes, teachers' approaches and methods along with prudent use of school resources and improvisation as far as academic activities are concerned (Wambui & Wahome, 2014).

The SMASSE Project Impact Assessment Survey (SPIAS) conducted from 2004 to 2008 by Center for Mathematics, Science and Technology Education in Africa (CEMASTEA) revealed that teachers' attendance of SMASSE INSET had statistically significant effect on students' achievement in biology (Kizito, 2008). In his study on Classroom Research found that teachers' use of hands-on activities during teaching and learning and effective ASEI/PDSI application leads to students' growth. ASEI advocates integration of practical work with theory lessons by providing a bridge to enhance learning (Oyaya, 2000). In SMASSE teaching approach, learners

are given opportunity to work in discussion groups followed by group reports in class through peer teaching (SMASSE, 2004). In cases where their ideas differ from those held by scientists, the teacher plays a role in making the students see sense from scientist's view in relation to their held ideas(Rabari, Kilonzo & Nge'eny ,2004).

All over the world, educationists have been struggling to develop strategies that can optimize the attainment of teaching and learning objectives (Rabari, Kilonzo & Ng'eny, 2004). The teacher is tasked with the responsibility of selecting and designing suitable learning experiences to provide optimal learning opportunities for the students. This should be in line with students' wide range of abilities, the great variety of teaching approaches and methods and the time and resources available. Recent studies in science education indicate that school science teaching should by all means be a learner-centered. The teacher's role is to be facilitator guide, counselors, motivators, and researchers. There must be student-centered activities, involving a lot improvisations in experience, there must be as many activities during any one lesson as possible(SMASSE, 2004). The PDSI and ASEI is therefore the tool in which this will be achieved for it is the teacher's approach to teaching and learning in order to achieve better results in biology.

2.6 Teacher's In-Service Professional Development Programme (TIPDP)

This is an in-service education for a teacher that is conducted in the absence of particular curricular changes (SMASSE, 2004). This is a continuous update of skills and abilities by the teachers. This helps teachers update themselves to effectively play their roles in a dynamic education system. Inyega and Thomson (2002) found out that chemistry teachers who went for in-service development program changed their attitude towards teaching approaches in science. This INSET provides a potential benefit to teachers' professional growth. Teachers' In-Service Professional Development Program (TIPDP) provides teachers with knowledge and skills to effectively teach science using the current curricular content. The degree of success for this INSET is judged by the competencies in the teachers' improvement of classroom practices but not in terms of its contribution to some overall instructional direction established for the schools. Collete and Chiapetta (1989) pointed out that, for teachers to be effective for promoting scientific literacy, they must be well prepared in their science subjects. In addition science teachers must have firm understanding of the nature of science and be updated with the current technological advances affecting our society every day. To ensure that teachers are constantly

updated, focus should be directed to the change of approaches, methodologies, in-service training and conferences at all levels (Ng'ang'a, 1999).

2.7 The Influence of Intrinsic Motivation on Students' Achievement

Erick (2015) suggests that intrinsic motivation tasks possess a certain optimum level of uncertainty and unpredictability and tend to be generally attractive. It's likely that schools whose students feel appropriately challenged to be academically successful and where the rewards of learning take the form of problem solving or successfully meeting challenges will have a higher level of motivation among the students. Different incentives are likely to be associated with different tasks and the manner in which these incentives are designed, presented or made available. Some students thrive in group learning situations where co-operation and personal interactions are operative, while others do well alone (SMASSE, 2004). Schools in which opportunities exist for all students to participate in ways that are best suited for personal needs and preferences are preferably more likely to have larger number of motivated students' hence higher achievement. There are also Socio-cultural factors which involve the degree to which an individual's social or cultural group supports tasks or goals and these affect success in learning. Schools where academic achievement is emphasized and rewarded might logically be expected to have more highly motivated students (Ng'ang'a, 1999).

2.8 The Influence of SMASSE Approach on Students' Motivation and Achievement

Motivation on the part of the school translates into motivation among students and staff through functioning of goals (Erick, 2015). He further stated that, 'personally valued goals are a central element in the schools' motivational structure ,a stimulus for action'. Athman and Monroe (2004) stated that an increase in student engagement by leaders can in turn improve academic achievement. Klug (2016) noted that school leaders have direct and indirect impact on the level of motivation and achievement of the students. The study also noted that although personal factors, differences in ability levels and personalities of every individual student usually fall outside the school leadership domain of influence, situational factors, motivational factors, are to some degree within a school leaders' power to control. The study put forward a measurement based approach for analyzing the effectiveness of instructional leaders and provides a convenient model for understanding the schools' influence on students' achievement and motivation. Barchok (2006) in his study found that all students irrespective of their class level, school type,

or amount of school support received from significant others have the potential of developing favorable motivation towards science achievement. Figure 1 shows a conceptual model for classroom learning and achievement.

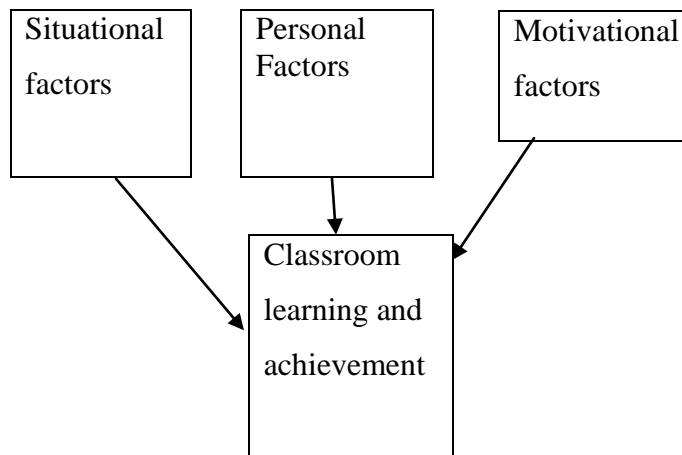


Figure 1: Klug’s Conceptual Model for Understanding Classroom Learning and Achievement.

Source: Klug (2016)

Figure 1 shows the effect of situational factors like the school instructional climate that shapes the attitude of the teachers, students and the community. Personal factors are: differences in ability levels and personality of individual student. Personal factors are beyond the school leaders to control while the motivational factors are; rewarding of success, functioning of school goals and the school culture. Classroom learning and achievement is viewed to be affected by motivational factors, personal factors and situational factors.

2.9 Theoretical Framework

This study is based on Keller’s ARCS model of motivation design. Keller’s (2014), motivation theory states four steps for promoting and sustaining the learning process, these are: Attention, Relevance, Confidence and Satisfaction (ARCS) model. The first is attention .The theory state two ways of gaining attention of the learners. These are: perceptual arousal and inquiry arousal. He also stated six methods of grapping attention of the learners. These are; learners must be actively involved by use of hands-on methods, variability, this is to better reinforce materials and account for individual differences in learning, there must be humor in learning. Hands-on

activities form the core reasons for improvisation and performance of many small scale experiments (SMASSE, 2004)

The second aspect of Keller's theory is relevance. He stated that in order to establish relevance of learning, learners must be motivated by use of concrete language and examples which learners are familiar with. The learners are also motivated to learn if the subject matter has present worth, future usefulness, there is use of modeling through use of guest speakers, videos and use of student tutors. The SMASSE lesson plans contain the section of prerequisite knowledge. Here the learners are expected to have some prior information about the topic to be introduced. The learners will then use the existing knowledge to build up the present knowledge skills. The third aspect of Keller's design is confidence. He stated that students must be allowed to understand their likelihood of success in the learning process. Learners must be aware of performance requirements and evaluation criteria. The fourth aspect of Keller's model is satisfaction. He stated that learning must be satisfying in some way, whether from sense of achievement, praise or mere entertainment. The learners must feel that the skill is useful by providing opportunities to use newly acquired skills in real setting.

Schein (2015) stated the Lewin's Three Stage Theory of Change commonly referred to as unfreeze, change (transition) and freeze (refreeze). The more we feel that change is necessary the more urgent we are motivated to change. Unfreezing and getting motivated to change is all about weighing up the advantages and disadvantages and deciding if the advantages outnumber the disadvantages before you take any action. Students become motivated to change when the teaching approaches are relevant to their present and future needs. This theory relates with the present study in that change is required in the teaching approach that enhances achievement in biology.

2.9.1 Conceptual Framework of the Study

The conceptual framework of the study is adopted from the Keller's ARCS model of motivation design for the dependent Variables. For this study, the model has been adopted since the variables to be studied are related. The factors within the SMASSE approaches are; improvisation of laboratory equipments and materials, performance of many small scale experiments, use of worksheets in practical and peer teaching in relation to the regular teaching methods. In this model, the SMASSE approaches are generally hypothesized to influence stu-

dents' motivation and achievement in biology.

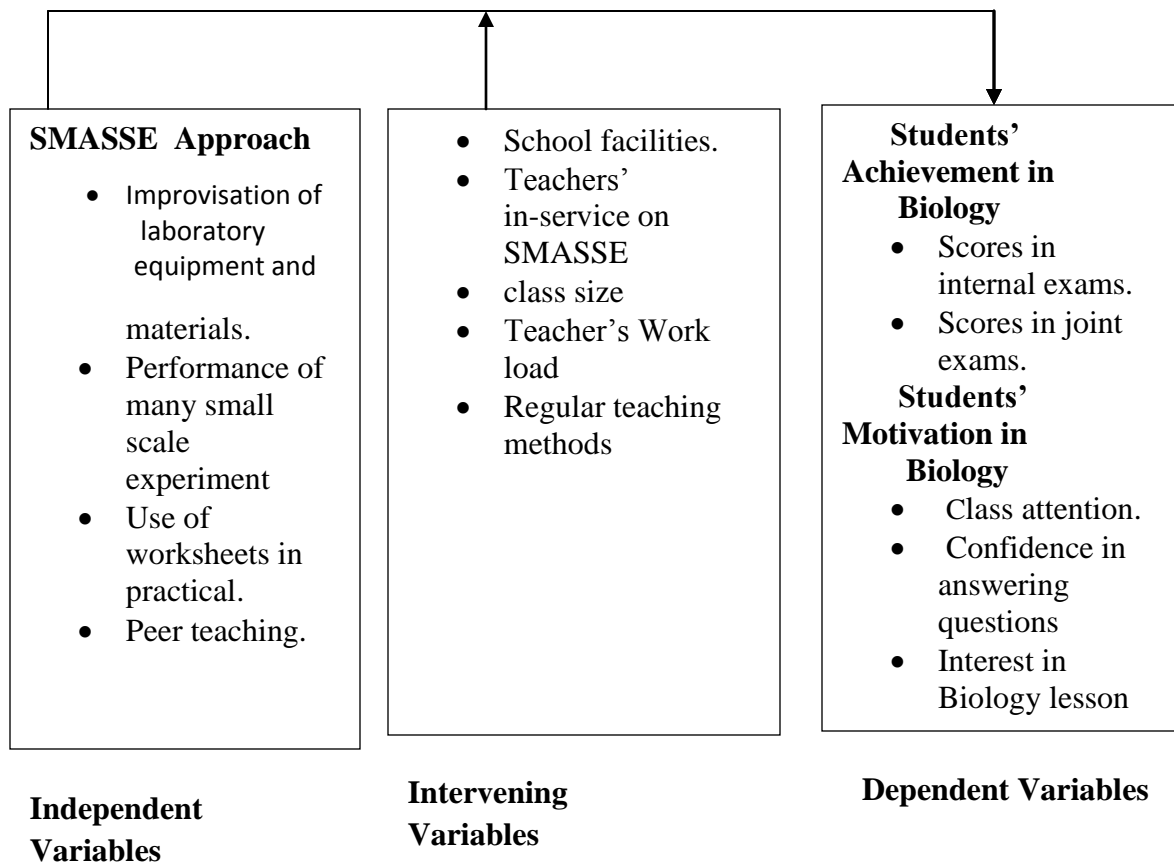


Figure 2: Conceptual Framework of the Study.

In conceptualizing the study, the researcher attempted to point out how the independent variable (SMASSE teaching approach) interacts with the dependent variables motivation and achievement as shown in figure 2. The study hypothesized that for high educational out put (motivation and achievement) the SMASSE teaching approach has to be adopted by teachers. Teachers need to adopt the SMASSE teaching approach in order to actively involve the learners. SMASSE approach is hypothesized to be intervened by the following variables: the school facilities, teachers' gender, class size, teachers' workload and the regular teaching methods. The influence of the intervening variables especially those related to the students and school were controlled by randomization (Mugenda & Mugenda, 2013). It was also controlled by sampling teachers with same training in SMASSE programme, same workload; The researcher ensured that those schools selected had the same facilities, same class sizes. This was done to ensure that

these variables did not interfere with the independent and dependent variables. The independent variables were; improvisation of laboratory equipments and materials in situations where the conventional materials and equipment are not available, performance of many small scale experiments at least for all the lessons in form three biology, use of worksheets and peer teaching. These variables are hypothesized to influence students' achievement in terms of scores in internal exams and scores in joint exams. These variables are also hypothesized to influence motivation on students' class attention, confidence in answering questions and interest in biology lessons, relevance and satisfaction.

2.9.1 Research Gaps

The study tried to explore the influence of SMASSE teaching approach on students' motivation and achievement in Biology in Bomet Sub-County between 2004 and 2013 when the programme ended. This is an area which has not been studied and therefore necessary so as to enable students, teachers and education stakeholders to make informed decision on the future of the programme.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents research design that was used in the study. This section provides a discussion which focuses on research design, location of the study, target population, sampling procedures and sample size, research instruments, piloting of the research instruments, data collection procedure, data analysis and data presentation.

3.2 Research Design

This is an *ex-post facto* research using the causal-comparative design. In this research, investigators attempt to determine the cause or consequence of difference that already exist between or among groups of individuals (Fraenkel & Wallen, 2009). This method is used to determine the cause or consequence that exist between variables by observing an existing condition or state of affairs and research back in time for plausible causal factors (Kasomo, 2006). The advantage of causal-comparative research is that, they are conducted solely as an alternate to an experimental research which is relatively costly (Fraenkel & Wallen, 2009). The major disadvantage to this research is that it is difficult to control threats to internal validity because the manipulation of the independent variables has already occurred. This is because relationship can be identified but causation can't be established fully. For this study, achievement in biology was due to the students' exposure to SMASSE approach and other strategies employed by the individual schools.

3.3 Location of the study

Bomet Sub-County is one of the five Sub-Counties in Bomet County. It lies between latitudes $0^{\circ} 29'$ and $1^{\circ} 03'$ South of the equator and longitudes $35^{\circ} 05'$ and $0^{\circ} 35'$ East. It borders Narok County to the East, Sotik Sub-County to the West and Chepalungu Sub-County to the South. The Sub-county landscape is hilly and valleyed. The altitude varies between 1800-3000 meters above sea level. The communities here are mainly agriculturalists; planting maize and tea and keeping livestock. Bomet Sub-County was chosen because of proximity to the place of work and most of the sampled schools were accessible. Most of the roads were passable and it was possible to reach most of the schools on time.

The fact that there was no similar study that had been taken in the Sub-County was another factor that necessitated the study to be carried out in the sub-County.

3.4 Population of the Study

The target population for the study was secondary school students doing Biology in Bomet Sub-County. Form three students were the accessible population. There were approximately 3000 Form three students in 2016 in Bomet Sub-County. Form 3 students having been in the school for three years, were better placed to understand different aspects of SMASSE. Though teachers are supposed to use the teaching approach across the classes, Students in Form 3 were better placed and able to respond to the questionnaire since they have been exposed for two years to the approach. Form 2 and Form 1 had not covered much in the subject to make informed decision in answering the items on the questionnaire. Form 4 was not involved since it was an examination class and could not be able to objectively respond to the question statements on the questionnaire. The study also involved Biology teachers who were teaching the classes. The teachers were in-serviced on SMASSE approaches and therefore were in a position to provide relevant information required in the study.

3.5 Sampling Procedures and Sample Size

The study used stratified and simple random sampling technique to select the participating schools and students after establishing the different categories of schools in the sub-county. There are approximately 56 established secondary schools in Bomet Sub-County with 2 divisions. These are Bomet Central and Longisa Divisions. The sampling procedure ensured that every division was represented by proportionate number of schools. To ensure that the characteristics of the sample reflected the characteristics of the population, a proportionate number of students were taken. Nassiuma (2000) recommends the formula shown below for determining sample size for a finite population. This formula was used to obtain the number of the sampled schools.

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

Where:-

n=required number of schools

N=the given number of schools

C= Coefficient of variation in this case 20%=0.2

e=Margin error in this case 0.05

$$n = \frac{56 \times (0.2)^2}{(0.2)^2 + (56-1)(0.05)^2}$$
$$= 12$$

From the above expression 12 schools were selected to form the sample size. Kathuri and Pals (2003) recommended the formula below for determination of sample size for a finite population. This formula was used to obtain the sample size in the present study. This was the number of students that took part in the study.

$$S = \frac{X^2 NP(q)}{d^2 (N-1) + X^2 p (q)}$$

Where:

S= required sample size

N=the give population size

P=proportion in the target population estimated to have the characteristic being measured (.5 is to be used in the study)

q=1-p

d=the level of significance set (.05)

X²= table value of chi-square for one degree of freedom (3.841 for 0.95 level of confidence). There were 3000 students in form three in Bomet-Sub-County in 2016. The sample size using the above formula was:

$$S = \frac{3.841 \times 3000 \times 0.5(1-0.5)}{(0.05)^2(3000-1) + 3.841 \times 0.5(1-0.5)}$$
$$= 340$$

A total of 340 participated in the study, where each of them filled the questionnaire correctly. Twenty two teachers were sampled to fill the questionnaires and majority did so correctly, as others did not provide all the information required, for instance the data on results. There were a proportionate number of boys and girls. According to the records obtained in the statistics office in Bomet Sub-County, there were approximately equal number of boys and girls. The study involved 170 girls and 170 boys. The study involved various types of schools. Using this information, the distribution was as follows.

Table 5: Sample Size per School Type.

School type	Total number of schools	Total number of girls	Total number of boys	Total
Girls' schools	4	85	-	85
Boys' schools	4	-	85	85
Co-educational	4	85	85	170
Total	12	170	170	340

Table 5 shows the maximum number of boys from every boy's school and number of girls in every girls' schools. There was an equal number of single sex and co-educational schools in the two divisions. Not all students successfully filled the questionnaires as required.

3.6 Instrumentation

The study used Questionnaires that contained questions on various aspects of students' motivation and achievement in biology. This was because questionnaires were easy to administer and the respondents found it easier to respond to the statements contained in it. There were two types of questionnaires.

3.6.1 The Questionnaires

The researcher used two questionnaires, namely;

- (i) Students' Motivation in Biology Questionnaire(SMBQ)
- (ii) Teachers' Questionnaire on Students' Achievement in Biology (TQSAB)

The instrument contained statements which the respondents were required to answer objectively. The statements consisted of closed ended items that adopted a Likert rating scale and open ended items that tested the respondents' opinions on various aspects of the variables that were studied.

(i) Students' Motivation in Biology Questionnaire (SMBQ)

The Students' Motivation in Biology Questionnaire (SMBQ) consisted of section A that contained students' biodata, that covered respondents' background information, section B contained 9 questions state. These covered students' opinions on SMASSE teaching approach and the classroom practices that indicated actual use of the SMASSE approach. section C

consisted of 24 questions statements covering all aspects of SMASSE teaching approach. These are: the use of improvisation in teaching and learning of biology, use of small scale experiments, use of work sheets in practical, bridging of the topic with the improvised materials and peer teaching.

(ii) Teachers' Questionnaire on Students' Achievement in Biology (TQSAB)

The Teachers' Questionnaire consisted of 4 questions that covered data on teacher's age, educational level, length of service and 11 questions on teaching methods in terms of preference, students' achievement in previous joint examinations and internal examinations, information on Teachers' In-service Professional Development Program (TIPDP) and teachers' opinion on SMASSE approach in teaching of biology.

3.7.1 Validity of the Research Instruments.

Welman and Kruger (2004) defined validity as the ability of the research instrument to measure what is intended to measure. Validity is done to find out whether the instrument meets the following validity tests; the content, construct and criterion validity. Kasomo, (2006) stated that content validity is used to establish the extent the instrument covers the various objectives and topics that are required. The content validity covered the classroom practices that accurately capture the influence of SMASSE teaching approach on students' motivation and achievement in Biology. While construct validity refers to the accuracy with which a test measures some meaningful aspects of SMASSE teaching approach. The instrument should be able to give students' and teachers' opinions on the teaching approach.

Kasomo (2006) stated that, criterion validity is to measure whether the instrument is able to establish a rule, standard in which a judgment is based. The instrument should be able to provide accurate information in which future decisions can be made concerning SMASSE approach in relation to its influence on motivation and achievement in Biology. To ensure that the instrument measure what is intended to measure, the instrument will be scrutinized by the supervisors and colleagues from the Department of Curriculum Instruction and Educational Management.

3.7.2 Reliability of the Research Instruments.

Frankel and Wallen (2009) defines reliability as the consistency of the measurement or the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. The research questionnaires were piloted in four schools in Sotik Sub-County, before administering to the selected sample of students and teachers. The respondents used in the pilot were not involved in the actual study. The collected information was analyzed to come up with numerical data and codes that facilitated determination of the reliability of the instrument. The collected information was subjected to the internal consistency reliability test. Kasomo (2006) stated that this method requires the researcher to administer the instrument only once to the same individuals. Key (2014) stated that internal consistency method provides a unique estimate of reliability for the given test administration. The study used Cronbach's alpha to estimate reliability co-efficient of the instrument. The Cronbach's alpha expression estimates reliability by grouping questions in the questionnaire that measure the same concept. The expression splits all question statements in the instrument in every possible way and computes correlation values for all of them. The coefficient alpha is an internal consistency index designed for use with tests containing items that have no right answers (Key, 2014). This is a very useful tool in educational research because instruments in these areas often ask respondents to relate the degree to which they agree or disagree with a statement on a particular scale. For the information obtained in this study to be used for generalization, the instrument was subjected to this reliability test. The threshold for acceptance was ≥ 0.7 .

Table 6 shows a summary of the reliability coefficients obtained on each scale as well as the overall reliability of the instrument after the necessary adjustments.

Table 6: Reliability of the Research Instruments.

Measures	No. of items	Cronbach's Coefficient Alpha (α)
SMBQ	33	0.8391
TQSAB	11	0.7231

Table 6 shows that the reliability estimates for scales of SMBQ and TQSAB are 0.8391 and 0.7231 respectively. These reliability coefficients were deemed sufficient as by the Key, (2010) recommendation that values of above 0.7 is acceptable.

3.8 Data Collection Procedures

The permission to carry out this study was obtained from the National Commission for Science, Technology and Innovation through Graduate School of Egerton University and Faculty of Education and Community Studies. After obtaining the permission to carry out the research, the researcher then visited the County Director of Education and County Commissioner- Bomet who granted the permission after submitting the relevant documents. The researcher then visited the schools through the head teachers and heads of department. The questionnaires were then distributed to the students by the head of the department of science and the biology teachers. The students were then given instructions on how to answer the questionnaires and that they understood them before they fill. After filling them, the researcher collected the questionnaires.

3.9 Data Analysis

Data that were collected through the questionnaires was verified by the researcher for consistency and completeness. Open ended questions were coded and data captured using Ms Office (Excel).The collected data was then analyzed in order to obtain the information required in the study. Data analysis was done based on the objectives and the hypotheses of the study. The data was analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics like the means and standard deviations were used to analyse scores on items on the questionnaire. Inferential statistics like the t-tests and regression coefficients were used to analyze scores on motivation and achievement. The hypotheses were tested at 95 % level of significance. Data were presented in form of tables.

Table 7: Summary of Variables and Statistical Tests of the Study.

HYPOTHESIS	INDEPENDENT VARIABLE	DEPENDENT VARIABLE	METHOD OF ANALYSIS
Ho1: There is no statistically significant influence of SMASSE approach on students' achievement in biology	SMASSE approach	Scores on Achievement in multiCats	Regression Analysis (R^2)
Ho2: There is no statistically significant influence of SMASSE approach on students' level of motivation in biology	SMASSE approach	Scores on motivation	Regression Analysis (R^2)
Ho3: There is no statistically significant student's gender difference in achievement in biology on exposure to SMASSE approach	Gender	Scores on Achievement in multiCats	t-test
Ho4 : There is no statistically significant students' gender difference in the level of motivation in biology on exposure to SMASSE approach	Gender	scores on motivation	t-test

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussions of the study. It has 5 sections; the first part gives summary results of the analysis of the characteristics of the respondents. The next 2 sections are the analysed results on the influence of SMASSE approach on students' achievement and motivation to learn biology. The following sections give the analysed results of the differences in students' achievement and motivation by gender when exposed to SMASSE teaching approach. The last section is the conclusions based on the research findings.

4.2 The Response Rate

The study presents a sample of 12 secondary schools drawn from a target of 340 students and 24 teachers. Table 8 shows a summary of the response statistics.

Table 8: Questionnaire Return Rate.

Respondents	sampled	Returned	Return Rate (%)
Teachers	24	22	91.7
Students	340	340	100

According to Edward, Robert Clark Disquiseppi, Pratop, Wentz and Kwan (2018), a questionnaire return rate of 80 % and above is absolutely satisfactory, while 60 % to 80% return rate is barely acceptable. This questionnaire return rate was therefore acceptable.

4.3 Characteristics of Respondents

This section gives an analysis of biodata of the respondents .The first section gives an analysis of the characteristics of the teachers who were the respondents. The second part gives an analysis of the students' number in each of the category of schools.

(i) Teachers Biodata

The teachers were to indicate their gender, age, highest education level. Those teachers who participated in the study were teaching Form 3 of that year. The information obtained was analysed based on the objectives of the study. At least two teachers from the sampled schools

filled the questionnaire though others did not provide all the information required. Teachers A total of 16 teachers filled the questionnaire correctly, translated to 67% return rate. The results are shown in Table 9.

Table 9: Teachers' Biodata

Characteristic n = 22	Scale	Frequency	Percentage
Gender	Male	14	62.5
	Female	8	37.5
Age	30 years and below	10	50.0
	31 - 40 years	8	36.4
	41 years and above	4	13.6
Highest education level	Diploma	3	13.6
	Higher Diploma	3	13.6
	Degree	14	63.8
	Masters	2	9.0

The results in Table 9 show that more than half of the teachers are males in the sampled schools. Majority of the sampled teachers are at the ages of below 30 years. The results also show that few have attained masters degrees. Males teachers are more compared to females in the sampled schools.

(ii) Students' Number per Category

In this section, students were to indicate their gender and the school type. Each category of school was represented as per the sample. Table 10 shows the information obtained.

Table 10: Students' Number per Category

Characteristic n = 340	Scale	Frequency	Percentage
Gender	Male	192	62.5
	Female	148	37.5
School type	Boys' School	78	22.9
	Girls' School	78	22.9
	Co-Educational (Mixed)	184	54.1

Table 9 shows that 62.5% of boys and 37.5% of girls participated in the study. The disparity came as a result of unequal number of both genders in mixed schools. Some of the mixed schools had more boys compared to girls in that class.

4.4 Influence SMASSE Teaching Approach on Students' Achievement in Biology.

This section gives the frequencies in which teachers use the various teaching approaches in teaching the subject during the period of study. The teachers were to indicate the frequency in which they employ a particular approach when teaching Biology. Table 11 shows the results of the frequencies in which a particular teaching approach is used by the teachers.

Table 11: Frequency of Use of Teaching Approaches

Teaching approach	n = 22	Very often	Often	Occasionally	Rarely	Never
SMASSE		6.3	50.0	12.5	31.3	-
Didactic		6.3	25.0	-	68.8	-
Heuristic		18.8	12.5	18.8	50.0	
Constructivist		68.8	31.3	-	-	-
Empiricist		25.0	56.3	12.5	6.3	-
Expository		31.3	18.8	-	31.3	18.8

Table 11 shows that more than half (56.3 %) of the respondents often used SMASSE approach and less than half used expository approach in content delivery in the subject. Didactic approach seemed unfamiliar with the teachers as there was no rating on the lower scale. Constructivist approach scores highly though the respondents did not rate it on the lower scale. Empiricist and heuristic approaches fared well as per the respondents' perception. Table 12 shows various combinations as per the respondents

Table 12: Combination of Preferred Teaching Approaches

Combination	n = 22	Teaching approach	Frequency	Percentage
Combination 1		SMASSE	8	36.4
		Lecture	4	18.2
		Constructivist	2	9.1
		Expository	8	36.4
Combination 2		Lecture	4	18.2
		Discovery	6	27.3
		Constructivist	12	54.5
Combination 3		SMASSE	4	18.2
		Discovery	2	9.0
		Constructivist	4	18.2
		Observation	10	45.5
		Expository	2	9.1

From the result, combination 3 is a suitable for teaching the subject. SMASSE, constructivist and observation approaches are considered suitable for teaching and learning of Biology in secondary schools (SMASSE, 2004). Combinations 1 and 2 are not suitable for teaching the subject since lecture method is not learner centered. (SMASSE, 2007).

Table 13 shows the frequencies with which teachers use SMASSE teaching approach when delivering biology content. Teachers were required to indicate whether they are using SMASSE approach in teaching of the various topics in the secondary school biology. There are a total of 16 topics in the secondary Biology syllabus, one was left out since it's the last topic which most teachers who don't complete the syllabus find a challenge to give responses on it.

Teachers were to indicate their responses using the following range of frequencies;

Most often, Often, Uncertain, Rarely and Never.

The coding was as follows.

Most often=5

Often=4

Uncertain=3

Rarely=2

Never=1

The analyses of their responses are shown in table 13.

Table 13: Use of SMASSE Recommendations when Teaching

Topic n = 15	Mean	SD
Introduction to Biology	3.31	1.25
Classification I	4.44	0.81
The cell	4.81	0.75
Cell Physiology	4.50	0.63
Nutrition in Plants and Animals	3.56	1.03
Transport in Plants and Animals	4.13	0.50
Gaseous Exchange	3.63	1.09
Respiration	3.56	1.03
Excretion and Homeostasis	4.06	1.24
Classification II	3.87	0.96
Ecology	3.81	1.22
Reproduction in Plants and Animals	2.88	0.89
Growth and Development	3.38	1.59
Genetics	3.25	1.18
Reception, Response and Co-ordination	3.76	0.45
SMASSE adoption index	3.31	1.25

Table 13 Shows that the average mean is 3.31 and Standard Deviation (SD) is 1.25. This analysis shows the adoption index of SMASSE teaching approach.

Analysis of students' achievement in Multi CAT test in all the participating schools for both males and females were as follows;

Mean = 6.40,

SD = 1.57

Regression analysis was used so as to give an in-depth understanding of the influence of the

approach in Biology. SMASSE adoption index and achievement in Multi-Cats was used in the analysis.

The analysis of the influence using regression is shown in table14.

Regress SMASSE adoption index (M = 3.31, SD = 1.25) and students achievement in Multi-CAT test mean score (M = 6.40, SD = 1.57)

Table 14: Regression Analysis on SMASSE Adoption and Students' Achievement in Biology

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error	Beta		
Constant	1.452	.894		1.624	.106
Adoption of SMASSE	1.283	.238	.384	5.386	.000

$r = .384, R^2 = .147, F(1, 168) = 29.012, p < 0.05$

The results in Table 14 show that there was a positive relationship ($r = .384$) between adoption of SMASSE approach and students achievement in Biology. The results further reveal that adoption of SMASSE explained 14.7% ($R^2 = .147$) of variation in achievement in biology and has a significant effect on it $F(1, 168) = 29.012, p < 0.05$. The regression equation used is expressed as follows:

$$Y = \beta_1 X + \beta_0 + \epsilon$$

Where: Y= Dependent variables, (Achievement and motivation).

X= Independent variable (SMASSE teaching approach).

β_1 = Slope of the line (Beta coefficient) for X

β_0 = Y intercept

ϵ = Standard error of coefficient Beta (Vera,2016)

These results indicate that adoption of SMASSE has a positive influence on biology achievement and a significant effect on the subject. These results do not support hypothesis one which stated that SMASSE approach do not significantly influence students achievement in biology. The hypothesis was thus rejected. From the results, the introduction of SMASSE approach has significantly

improved performance of the subject over the years. Majority of Biology teachers have embraced the use approach in teaching various topics and that learners have continually posted better results (CEMASTEА, 2016)

The findings of this study reveal that SMASSE approach favourably influences students' performance in biology. The findings of this study are consistent to the findings by CEMASTEА (2015) that the program promotes continuous improvement of teachers and eventually the students' achievement in the subject. SMASSE program was introduced as an intervention strategy to address issues on quality implementation of curriculum through learner centered teaching and learning (CEMASTEА, 2015). ASEI-PDSI approach considers the quality of classroom activities as critical to achieving effective teaching and learning. ASEI-PDSI approach to teaching and learning focuses more on student learning. The approach spells out what teachers should do to take care of high and low achievers. Learners tend to learn a lot more when they are active readers rather than passive recipients of information (CEMASTEА, 2016). SMASSE approach involves improvisation which is the practice of use of locally available resources, scaling down of teaching and learning resources or innovative ways of teaching and learning the content. Use of locally available resources helps in attaining maximum effect in learners (CEMASTEА, 2016). Figure 4 below show a pedagogical shift through ASEI lessons that teachers adopted.

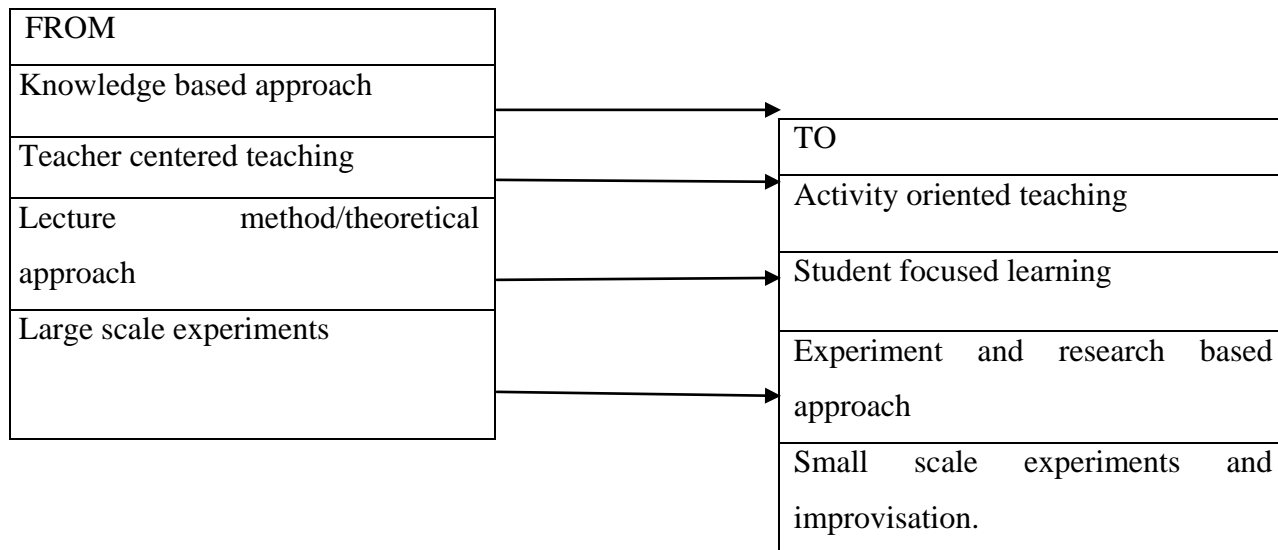
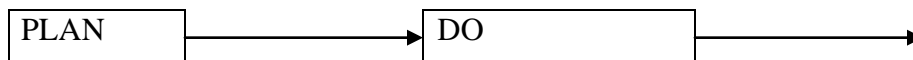


Figure 3: Pedagogical Shift through ASEI Lessons

Source: CEMASTEА (2016)

Figure 3 above show a shift in which teachers have gone through in their teaching methodology. Most of the classroom activities are carried out by the students and teacher becomes a facilitator. Teacher ensures that the learners are provided with the relevant resources and to fill the learning gaps at the end of every lesson.

Use of improvised materials which are locally available are convenient, economical for utilization and also raises learner’ interest and curiosity (CEMASTEА, 2016). The earlier seen negative behaviors observed in learners like lack of attention in class, frequent absenteeism and poor performance have significantly reduced. Paradigm shift in teaching methodology has greatly contributed to improved performance in the national examinations as shown by the results. Figure 4 shows the interaction between PDSI and ASEI as both teaching aspects in SMASSE approach.



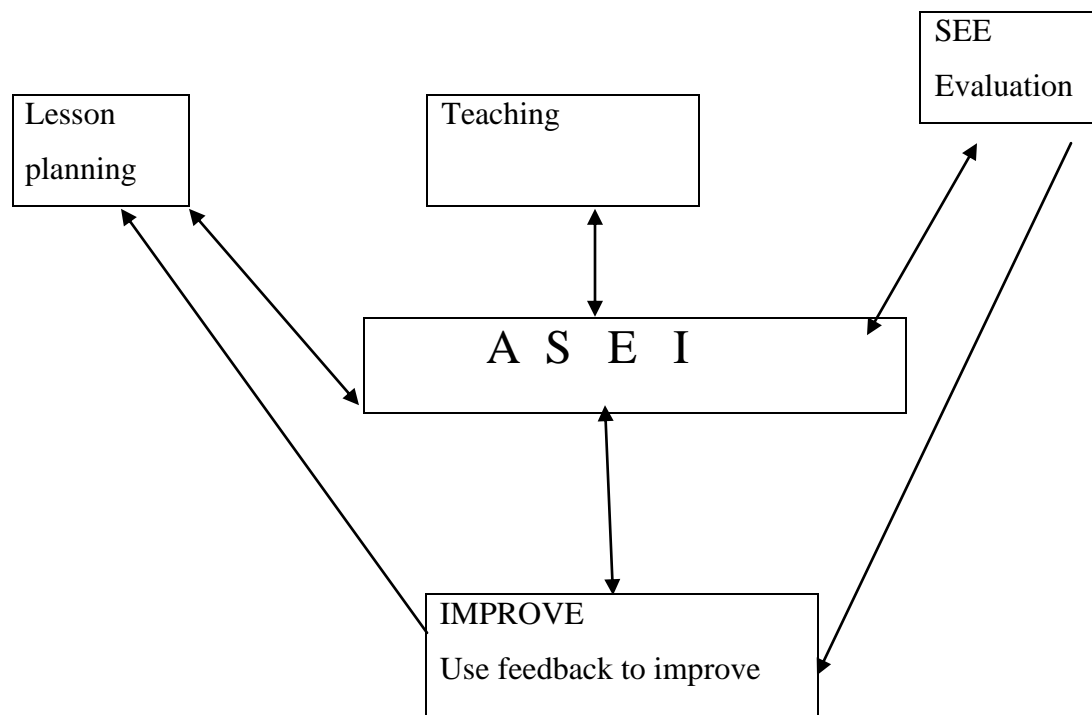


Figure 4: ASEI-PDSI Approach.

Source: CEMASTEА (2016)

Figure 4 show what SMASSE involves to bring about effective teaching and learning a classroom. The activities done by the teacher includes: planning of the lesson, actual teaching the planned lesson, evaluating the lesson after teaching and finally improving areas of deficiencies. On the other hand the students carry out activities that involve practical work using improvised materials where the conventional ones are unavailable (SMASSE, 2007).

4.5 Influence of SMASSE Teaching Approach on Students' Level of Motivation to Learn Biology

Measurement of motivation is important in trying to understand the contribution of a particular aspect in learning (CEMASTEА, 2016).The influence of SMASSE teaching approach on the level of motivation was sought out from the respondents. Their responses are shown in Table 15

Table 15: Motivation to Learn Biology

Statement n = 340	Mean	SD
Biology is my best subject	3.89	0.99
I enjoy learning biology	3.69	1.07
I often participate in biology symposiums	3.20	4.21
Science subjects are my best subjects in school	3.32	1.33
Materials and apparatus for learning biology are available in school	4.13	1.05
Practical activities in class has improved my participation in the science congress	3.94	1.32
Use of improvisation improves my interest in biology	4.32	0.87
Small scale experiments are interesting to carry	3.56	1.32
I finish my lesson assignments with discussion groups	3.31	1.36
Use of small scale experiments enables the biology teacher to complete the syllabus early	4.11	1.04
I am actively involved in practical activities	3.99	1.07
I attend biology lessons regularly and punctually	4.61	0.65
I practice solving and answering biology questions	3.79	1.09
I intend to study biology after form four	3.79	1.21
I have no problems handling biology practicals	3.14	1.42
I find activities in biology lessons meaningful	4.04	1.24
I usually get excited when it is time for biology practicals	3.58	1.23
I expect to get high scores in biology examinations	4.35	0.96
I usually get high marks in biology tests	3.82	1.22
Biology is an easy subject	3.84	0.60
Biology teachers uses improvised equipment frequently	3.89	0.99
Learning biology is relevant to my future career	3.69	1.07
I participate in peer teaching during biology lessons	3.20	4.21
Use of real materials and specimen makes biology lessons interesting	3.32	1.33
Use of worksheets during biology experiments improves my interest in learning	4.13	1.05
Motivation Index	3.94	1.32

SMASSE index calculated in objective 1- SMASSE adoption index Mean = 3.31, SD = 1.25
 Motivation Index - M = 3.94, SD = 1.32.

The regression analysis was then carried out to establish whether SMASSE teaching approach has an influence in the level of motivation in the subject.

Table 16 shows the regression analysis on the influence of SMASSE approach on motivation to learn Biology.

Table 16: Regression Analysis Results on Influence of SMASSE on Motivation to Learn

Biology

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error			
(Constant)	3.558	0.407		8.751	.000
SMASSE index	0.072	0.108	0.051	0.662	0.509

$r = .051, R^2 = .003, F(1, 168) = 438, p > .05$

The results in Table 16 reveal that the relationship between adoption of SMASSE and motivation to learn biology was positive and weak ($r = .051$). The results also indicate that adoption of SMASSE approach accounted for only 0.3 % ($R^2 = .003$) of variance in motivation to learn biology. The beta coefficient ($\beta = .051, p > .05$) shows that the explanatory variable is an insignificant predictor of the outcome. These results mean that adoption of SMASSE is not related to and has no effect on students' motivation to learn biology. On the basis of these results, Ho2 is accepted.

The results indicate that students could have been motivated by other factors other than SMASSE approach. These factors could be within or outside the school setting and that they could have contributed much to the perception of learners on the statements on the instrument

The findings of this study reveal that SMASSE approach has not contributed much to increase the level of motivation to learn the subject. The findings are in agreement with baseline findings (CEMASTE, 2016). Teachers themselves have been sensitized on the approach which could not

translate to students' influence. The findings of this study contradicted the past findings of Keraro, Wachanga and Orora, (2007), the study however explored the effect of cooperative concept mapping teaching approach on secondary school students. The present study explored the influence of SMASSE approach. Therefore the present study could not establish those factors hindering students' motivation on exposure to the teaching approach.

Ausubel (2018), learning theory describes motivation as a cognitive drive to achievement, drive for knowledge and understanding. The inner driving force begins the students' inner drive to explore, manipulate, understand and cope with the psychological environment. Suitable teaching approach is an extrinsic motivator to learn a specific subject. (KESI, 2011). The study describes that extrinsic motivation comes from outside an individual. An extrinsically motivated individual will work on a task even when they have little interest in it because of the anticipated satisfaction they will get from the reward.

SMASSE teaching approach is an extrinsic motivator to learn Biology because students expect to gain from good performance in the national examinations even if they are not interested in the subject. Extrinsic motivation however is effective for a short time, since after removing the reward, the motivation ceases.

4.6 Students' Gender Differences in Achievement in Biology

The study was attempting to find out whether there is any significant gender difference in achievement biology. This was done through analyzing of their performance in Multi-CATS by gender. The students' achievement is obtained from TQSA data. Table 17 shows comparison of students' Multi-CATS mean scores by gender.

Table 17: Comparison of Students' Multi-CAT Biology Mean Scores by Gender

Group	N	Mean	SD	Df	t-value	p-value
Male	192	6.50	1.47	168	2.972	.003
Female	148	5.90	1.07			

The t-test results in Table 17 show that the male students' mean score (M = 6.50, SD = 1.47) was higher (M = 5.90, SD = 1.07) than that of the females. The difference between the two means was statistically significant in favour of the males at the 0.05 level, $t(168) = 2.972, p < .05$. The

results show that gender affects students' achievement in Biology. The third hypothesis which stated that there is no significant gender difference in students' achievement in biology was rejected. From the results in Table 15, it can be deduced that in the Sub-County, most of the males are performing better than females when both are exposed to SMASSE approach. In the study, both Male and female schools of the same category sampled had the same facilities.

The findings of this study show that males are performing better than females in biology in the sub-county. The results are in agreement with the findings of Barchok (2006) that the majority of the students were in agreement that girls are not as good as boys in science subjects. Some of the reasons given by students in the same sub-county are that science practical is problematic to girls, they lose hope easily in science subjects and that they will not become scientists in the future. This negative perception is perhaps what made females to perform poorly in the subject. Socio-cultural believes that difficult tasks as been male domain and that girls were associated with lighter duties (SMASSE, 2004). This perception has led to the girls performing poorly especially in mixed schools. Gender stereotyping has been a challenge in most schools where teachers expect boys to perform better than girls (SMASSE, 2004). Early upbringing where societies restrict girls while boys are set free which in turn enhance more discoveries (SMASSE, 2004).

Gender stereotyping arises from distinct divisions of tasks boys and girls are associated with but gender is dynamic and changes with time (KESI, 2011). The society has drastically changed; most girls' schools are performing better than boys' in the national examinations. In the recently released examinations (2017), most of the top performing schools and students come from girls' schools. This therefore means that the society's dynamics have shifted towards gender equity and equality. Gender can be Constructed and deconstructed (SMASSE, 2009). Through the process of socialization, different societies assign different roles to boys and girl and men and women. Figure 5 shows a dichotomy of cultural and socio- cultural differences existing in human beings.

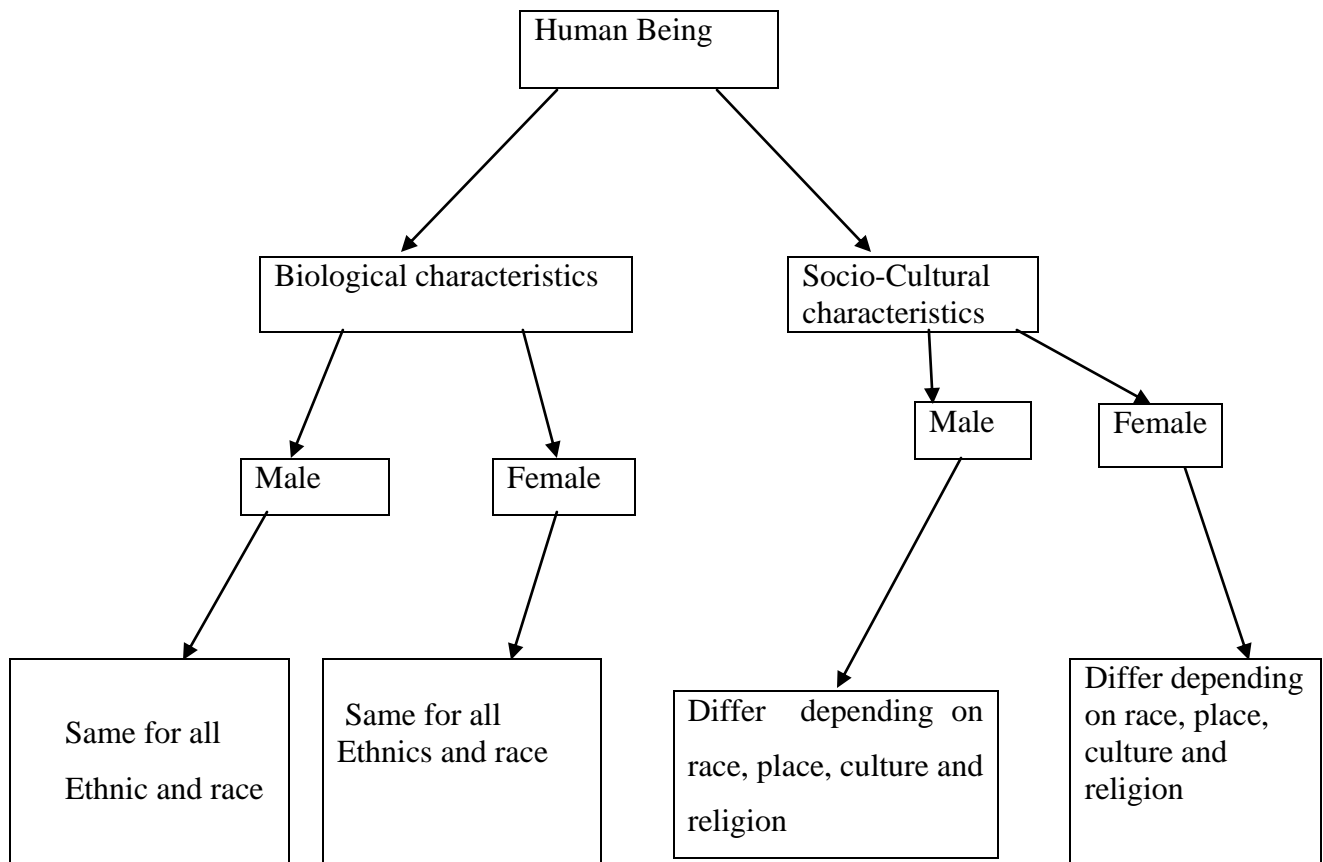


Figure 5: Biological and Socio-Cultural Differences between Males and Females

Source: CEMASTEА (2015)

Figure 5 shows that male biological characteristics are different from those of females in every respect. Socio-cultural difference exists depending on race, place, culture and religion. Biological differences are for instance differences in genitalia and the visible organs. The socio-cultural differences relate to tasks assigned at home and by the society. These tasks include construction of houses, household chores, and to some extent matters related to education. These biological and socio-cultural barriers have been deconstructed through socialization, education, gender equity and gender equality been experience in all sectors of the society in line with the Kenyan constitution (CEMASTEА, 2011).

4.7 Students' Gender Differences in Motivation to Learn Biology

The study used SMQ to get data on learners' perception on various aspects of SMASSE and whether it has any influence on students to learn biology. Table 18 shows a comparison of

students' motivation by gender.

Table 18: Comparison of Students' Motivation to Learn Biology Mean Scores by Gender

Group	N	Mean	SD	Df	t-value	ρ-value
Male	192	3.83	0.54	168	.224	.823
Female	148	3.81	0.60			

The results in Table 16 reveal that the differences between males ($M = 3.83$, $SD = 0.54$) and females ($M = 3.81$, $SD = 0.60$) mean scores on motivation to learn biology was not statistically significant at the 0.05 level, $t(168) = .224$, $p > 0.05$. This implies that the students' motivation to learn biology is not affected by gender since the mean score of the males is comparable to that of the females. The results support the fourth hypothesis which stated that there is no significant gender difference in students' motivation to learn biology. Therefore H_{o4} is accepted.

The results in Table 18 indicate that both genders are equally motivated on exposure to SMASSE approach. The schools on all categories showed strong indication that the approach has significantly contributed to the liking of the subject as shown by the improvement in the results.

The fourth objective of this study sought to find out whether there is gender difference in motivation to learn biology on exposure to SMASSE approach. The results show that both genders are equally motivated to learn the subject. The results are inconsistent with the findings on the second objective of the study where the influence of SMASSE approach on motivation to learn the subject was sought.

The instrument used captured both intrinsic and extrinsic motivation levels. Based on the results both boys and girls showed insignificant difference in the level of motivation in the subject. The results contradicted the findings by Barchok (2006) where girls had higher interest in science subjects than boys. Girls found science more useful in their daily life than boys therefore they had higher level of motivation by extend than boys. This means that all students irrespective of gender are equally motivated by factors within or outside the school setting other than SMASSE teaching approach.

The finding of the study concurs with Ausubel's view on motivation to learn. The Study states

that motivation will not have a direct impact on learning but through an indirect way of enhancing and promoting, moderating and intensifying excitement to learn (Ausubel , 2018). In kenya , a lot of advocacy on the importance of science has been undertaken. This campaign might have influence favorably the perception of science by the public. This is the same reason why there is lack of gender differences on motivation to learn biology.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter has six sections. The first part deals with the summary of the findings of the study, the second part gives the summary of the findings. The third section gives the conclusions of the findings and the next is the implications of the findings of the study. The fifth part gives the recommendations and the next is recommendation for improvement in biology education. The last part covers other areas for further research.

5.2 Summary of the Findings

The findings of the study can be summarized based on the objectives of the study. The first objective sought to find out whether SMASSE approach influences students' achievement in biology. The findings showed that there is statistically significant influence of the independent variable on student achievement in the subject. The second objective sought to find out whether SMASSE approach influence students' motivation to learn biology. The findings showed that there is no statistically significant influence of the independent variable on the dependent variable. The third objective assessed whether there was gender difference in biology achievement on exposure to SMASSE approach. The findings showed that there was statistically significant difference on the same since males performed better than females.. The fourth objective assessed whether there is gender difference in the level of motivation in biology. The study showed that both males and females were equally motivated on exposure to SMASSE approach.

5.3 Conclusions

On the basis of the findings of this study, the researcher made several conclusions which are related to the objectives of the study. They are as follows;

- i) Use of SMASSE teaching approach positively influences secondary school students' achievement in biology.
- ii) Use of SMASSE teaching approach has no influence on secondary school students' motivation in biology.
- iii) There is gender difference in achievement. The findings showed that males perform better than females when both are exposed to SMASSE approach.

- iv) The female and male students have equal levels of motivation once they are exposed to SMASSE approach.

5.4 Implications of the study

The findings of this study have some implications to biology education and SMASSE program. The findings of this study show that teachers have adopted the use of SMASSE teaching approach. The adoption has had a positive influence on achievement in the subject and possibly all other subjects covered in SMASSE program. The teachers should therefore strive to continue using the approach not only in Bomet sub-county but also in other counties in the country. Most teachers have been sensitized on the program and there is a need for the ministry of Education to set policies that involve teachers and other stakeholders

The findings of this study also show that students' achievement has been attributed to exposure to the approach as an intervention undertaken at the school level. School programs together with emphasis on the approach could as well influenced students' performance and that teachers might have resorted to SMASSE approach to teaching and not overlooked or overshadowed by other methodologies. Motivation on the other hand seems not to have been linked to SMASSE approach. Students might not have been sensitized by their teachers on the concept of the approach leading to the indifference.

With regard to the findings on gender difference in learning biology, Motivation and achievement seems to differ. Males are performing better than females when both are exposed to the approach. There is therefore a need for teachers and other stakeholders to come up with strategies to bridge this gap. There is an equal level of motivation on both genders on exposure to SMASSE approach. It's however difficult to find point out exactly what might have caused this difference in the present study.

5.5 Recommendations

Based on the research findings, the following recommendations have been identified. First is that Universities and colleges should revise their curricular to incorporate SMASSE teaching approach in the development of the course content. This is in order to bridge the missing link between what is in the field and what is learnt in these institutions. Secondly the QUASO should design monitoring tools to ensure that the program is actually implemented in the classroom.

Thirdly is that teachers should incorporate Information and Communication Technology (ICT) while using the SMASSE approach in teaching to improve students' motivation. School managers should provide adequate resources for the SMASSE program. According to report by (CAMASTE, 2016), very few number of school principals practice resource mobilization and guide resource use and they rarely coordinate teachers to mobilize resources and that only 17 % do so. The report went further to state that 23 % of them rarely ensure that there are adequate laboratories that are equipped with necessary resources.

5.5.1 Recommendation for Improvement in Biology Education

Based on the findings of this study, the researcher made some recommendations that biology educators as well as education stakeholders can apply to improve motivation and achievement among secondary school students. Even though the results of this study were generalized to secondary school students in Bomet Sub-County, the recommendations however can be extended to cover other Sub-counties where SMASSE program has been undertaken. The recommendations are;

- i) Irrespective of the type and category of schools, the program should be incorporated in the teacher training curriculum in Universities and colleges.
- ii) Since all students showed improved performance when exposed to SMASSE approach irrespective of the type and category of schools, the program should be incorporated in the teacher training curriculum and in the universities. The teachers should also incorporate the use the approach in other subject,
- iii) Biology teachers should at all times expose the students irrespective of gender to the approach to increase their level of motivation to learn the subject.
- iv) Since gender is not a limiting factor in the level of motivation of students to learn biology,all the school activities should be geared towards promoting the use of the approach in other subjects.
- v) Since there are disparities in the achievement in both gender as shown by the findings, teachers and other stakeholders should strive to bridge the gap as to why boys' schools are performing better than girls' schools in the subject. In addition, biology educators should strive to remove gender bias materials in the curriculum, class instructions and activities. Materials such as charts and pictures as well as other instructional materials

should be devoid of gender stereotypical views relating to adult roles as well as aptitude and ability in biology and related courses.

- vi) Policy makers and education authorities as well as CEMASTEAs need to increase efforts in finding solutions to the challenges faced by teachers in implementing the SMASSE program in their schools.
- vii) Biology teachers should strive to make the subject a favorite in terms of instrumental value in advancing scientific careers as well as cultural aspects faced by the students.

5.5.2 Recommendations for Further Research.

The researcher identified some areas which require further investigation in order to have more insight in the relation between achievement and SMASSE approach and Motivation and SMASSE approach as well as enriching the present knowledge. The suggested areas are:

- i Replication of the present study in other Sub-Counties in Kenya to find out whether the same trend will be observed.
- ii An investigation into the influence of selected factors on adoption of SMASSE approach in teaching and learning of biology.
- iii Further investigation into the influence of motivation on achievement in biology education

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APPENDIX A: STUDENTS' MOTIVATION IN BIOLOGY QUESTIONNAIRE
(SMABQ)

Instructions

- I). The questionnaire contains a number of question statements. Read them and answer.
- II). Your personal feelings or opinions on each question statement is required, please answer all the questions as quickly as you can.
- III). Names are not required.

SECTION A: BIODATA

- 1. Sex (tick box)
 - Male
 - Female

- 2. Present class-----

- 3. Type of the school (tick box)
 - a)Boys' School
 - b) Girls' School
 - c) Co-educational (mixed) school

SECTION B

In this section, please indicate the extent to which you agree on the following statements. Rate them as, **Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree** on the way you perceive them.

KEY

SA = Strongly Agree

A= Agree

U= Uncertain

D= Disagree

SD=Strongly Disagree

Coding:

SA=5

A=4

U=3

D=2

SD=1

S/NO	Statement	SA	A	U	D	SD
I	I perform practical in every biology lesson					
Ii	Use of practical in Biology improves my understanding					
Iii	Group discussions makes me learn Biology better					
Iv	Use of improvisation improves my understanding of Biology					
V	Writing discussions work on the board improves my participation in Biology					
Vi	Participation in class experiments has made me enjoy Biology					
Vii	Use of 'Realia' in Biology improves my understanding					
Viii	Use of worksheets in laboratory has made learning of Biology easier					
Ix	Peer teaching has made me enjoy group discussions					

SECTION C

5. In this section, please indicate whether you strongly **Agree**, **Agree**, **Uncertain**, **Disagree** or **Strongly Disagree** with the statements by ticking the letters that best describe your level of agreement or disagreement.

KEY

SA= Strongly Agree

A= Agree

U= Uncertain

D= Disagree

SD= Strongly Disagree

Coding:

SA=5

A=4

U=3

D=2

SD=1

S/NO	Statement	SA	A	U	D	SD
I	Biology is my Best subject in secondary school					
Ii	I enjoy learning Biology					
Iii	I often participate in Biology symposiums					
Iv	Science Subjects are my best Subjects in school					
V	Materials and apparatus for learning Biology are available in my school					
Vi	Practical activities in class has improved my participation in science congresses					
Vii	Use of improvisation improves my interest in Biology					
Viii	Small scale experiments are interesting to carry out					
Ix	I finish my lesson assignments with discussion groups					
X	Use of small scale experiments enables Biology teacher complete the syllabus early					
Xi	I am actively involved in practical activities					
Xii	I attend Biology practical lessons regularly and punctually					
Xiii	I practice Solving and answering Biology questions					
Xiv	I intend to study Biology after form four					

Xv	I have no problem handling Biology practical					
Xvi	I find activities in Biology Lesson meaningful					
Xvii	I usually get excited when it is time for Biology practical					
Xviii	I expect to get high scores in Biology examinations					
Xix	I usually get high marks in biology examinations					
Xx	Biology is an easier subject					
	Biology teacher uses improvised equipment frequently					
Xxi	Learning Biology is relevant to my future career					
Xii	I participate in peer teaching during biology lessons					
Xxiii	Use of realia make me understand biology lessons better					
Xxiv	I normally use worksheets during biology experiments					

6. State the difficulties you encounter when learning Biology.

.....

.....

.....

APPENDIX B: TEACHERS' QUESTIONNAIRE ON STUDENTS' ACHIEVEMENT IN BIOLOGY (TQSAB)

Fill in the questionnaire in the spaces provided.

1. Sex Male

Female.....

2. Age

3. Educational Level.....

4. Length of service

5. a) The table below shows a list of approaches used by teachers in teaching biology. Rate them as; **Most often, Often, Uncertain, Rarely, Never** for you by ticking in appropriate column of your choice. This is the frequency in which you use them.

Coding:

Most often=5

Often=4

Uncertain=3

Rarely=2

Never= 1

Rating Approach	Most often	Often	Uncertain	Rarely	Never
SMASSE					
Didactic (Lecture)					
Heuristic (Discovery)					
Constructivist (Class discussions &class demonstration)					
Empiricist					

(Observation)					
Expository (Teacher-Centered)					

5(b) From the list of the teaching approaches listed above, choose the best 3 in order of frequency in which you use them.

(i).....

(ii).....

(iii).....

c) Give reason for your answers above for:

(i).....

(ii).....

(iii).....

6. The list below shows topics covered in Secondary School Biology course. Indicate the extent in which you use the SMASSE approach in teaching them. Rate them as:

Most often, Often, Uncertain, Rarely and Never

Coding:

Most often=5

Often=4

Uncertain=3

Rarely=2

Never= 1

No	Topic	Most often	Often	Uncertain	Rarely	Never
A	Introduction to Biology					
B	Classification I					
C	The Cell					
D	Cell Physiology					
E	Nutrition in Plants and animals					
F	Transport in Plants and Animals					
G	Gaseous Exchange					
H	Respiration					
I	Excretion and homeostasis					
J	Classification II					
K	Ecology					
L	Reproduction in Plants and Animals					
M	Growth and Development					
N	Genetics					
O	Stimulus and Response					
P	Support and Movement					

7. Please indicate the performance in Multi-CATS mean scores for Biology in the table below.

	2010	2011	2012	2013	2014	2015	2016
	Mean	Mean	Mean	Mean	Mean	Mean	Mean

Total Mean

8. Please indicate the term average mean scores for Form Three Biology in the table below.

Term	Term 1	Term2	Term 3	Total
------	--------	-------	--------	-------

Total Mean

9. How do you describe the trend in students' achievement in biology for the last five years?

Tick the appropriate choice.

Improved greatly ()

Improved ()

Not changed ()

Declined ()

10. To what extent do you attribute this performance to SMASSE approach?

To a large extent ()

To a small extent ()

Not at all ()

11. Do your results in external exams consistent with the internal exams?

Yes () No ()

If no, what factors contribute to this.....

.....
.....
.....

12. Is your head teacher supportive whenever you require materials for teaching and learning biology?

Yes () No ()

13. Comment on the areas which you feel should be improved in future on SMASSE teaching approaches.....

.....
.....

14. Give the areas you feel should be included in any future Teachers In-service Professional Development Program.....

.....

APPENDIX C: RESEARCH PERMIT AUTHORIZATION



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/16/2400/9069**

Date: **4th April, 2016**

Richard Kipkoech Mutai
Egerton University
P.O Box 536-20115
EGERTON.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***“Influence of SMASSE teaching approach on secondary school students’ motivation and achievement in biology in Bomet Sub-County, Kenya,”*** I am pleased to inform you that you have been authorized to undertake research in **Bomet County** for a period ending **1st April, 2017.**

You are advised to report to **the County Commissioner and the County Director of Education, Bomet County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.


BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Bomet County.

The County Director of Education
Bomet County.

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegrams: "DISTRICTER", Bomet
Telephone: (052) 22004/22077 Fax 052-22490
When replying please quote



COUNTY COMMISSIONER
P.O BOX 71
BOMET - 20400

9th May, 2016

REF: EDU 12/1 VOLI (164)


All Deputy County Commissioners
Bomet

RE: RESEARCH AUTHORIZATION
MR. Richard Kipkoech Mutai of Egerton University

The above student has been authorized to carry out research on "Influence of SMASSE teaching approach on secondary school students' motivation and achievement in biology in Bomet Sub- County, Kenya," for a period ending 1st April, 2017.

Any assistance accorded to him would be much appreciated.

COUNTY COMMISSIONER
BOMET COUNTY.


B.J Leparmara
County Commissioner
BOMET COUNTY

c.c.

Richard Kipkoech Mutai



REPUBLIC OF KENYA
MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY
State Department of Education

Telegrams: "ELIMU",
Telephone: 052-2226
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COUNTY DIRECTOR OF EDUCATION
BOMET COUNTY
P.O. BOX 3-20400
BOMET.

When replying please quote
REF: CDE/BMT/AUTH/VOL.1/41

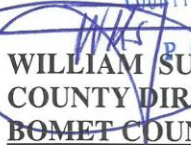
9TH MAY, 2016

RICHARD KIPKOECH MUTAI
EGERTON UNIVERSITY,
P.O BOX 536-20115,
EGERTON.

RE: RESEARCH AUTHORIZATION:

Reference is made to the letter dated 4th April, 2016 NACOSTI/P/16/2400/9069. The above mentioned person is hereby authorized to carry out research on "*influence of SMASSE teaching approach on Secondary School Students' motivation and achievement in Biology in Bomet Sub-County, Kenya*" for the period ending 1st April, 2017.

You should present this introduction letter to the Head teacher of a school you visit for identification.


COUNTY DIRECTOR OF EDUCATION
BOMET COUNTY
P.O. Box 3-20400,
BOMET.
WILLIAM SUGE
COUNTY DIRECTOR OF EDUCATION
BOMET COUNTY.